

ATA and ATAPI

This chapter presents the PC 99 requirements and recommendations for ATA (AT Attachment), ATAPI (ATA Packet Interface) controllers and peripherals. ATA is more commonly known as IDE (Integrated Device Electronics).

The ATA interface is one of the most widely used in the PC world. Originally intended only for hard drives, ATA support is being extended to additional device types and performance features.

The use of ATA in a PC 99 system is optional. If ATA is used, however, all components must comply with the requirements defined in this chapter.

Contents

ATA Controller Requirements	2
ATAPI Peripheral General Requirements	5
Plug and Play for ATA Controllers and Peripherals	5
Power Management for ATA Devices	7
ATA and ATAPI References	7
Checklist for ATA and ATAPI	9

ATA Controller Requirements

This section summarizes the specifications and standards for Windows-compatible ATA controllers.

1. Controller complies with ATA-2, ATA-3, and ATA/ATAPI-4 standards

Required

~~Recommended: ATA-3 compliance.~~

All ATA/ATAPI adapters (and peripherals) must meet the hardware and software design requirements listed in the current version of the ATA/ATAPI-4 Revision 17 standard or later.

Storage subsystems requiring advanced features such as command queuing should use IEEE 1394 for the storage interface. ATA Command Queuing is not recommended and future support of the ATA-4 queuing feature is not assured.

2. Bootable ATA controller supports El Torito No Emulation mode

Required

A bootable ATA storage controller must support the No Emulation mode defined in *El Torito—Bootable CD-ROM Format Specification, Version 1.0*, by IBM and Phoenix, or an equivalent method that supports the Windows NT CD-ROM installation process.

3. System BIOS and option ROMs support Int 13h Extensions

Required

The Int 13h Extensions ensure correct support for high-capacity drives, consistent drive-letter mapping between real mode and protected mode, and other capabilities for both Windows and Windows NT. Support for the fixed-disk access subset of Int 13h Extensions must be provided in the system BIOS and in any option ROMs for storage devices that include BIOS support.

Support for drives with capacities greater than 8.4 GB must be provided through the extended services (functions 4xh and greater) of the Int 13h Extensions as defined in T13-1226DT, rev4, 6-3-1997. The system BIOS should support the use of LBA addressing for drives with LBA addressable area greater than 16,515,072 sectors.

The Int 13h Extensions are defined in the Windows NT 5.0 DDK and in the “Layered Block Device Drivers” section of the Windows 98 DDK.

4. ~~Controller and Peripherals~~ support media status notification

Required

For CD-ROM and DVD-ROM, manufacturers must comply with ANSI NCITS T10 Multi-Media Command Set-2 (MMC-2) standard for all provisions defined in the Media Status Event Notification. The most recent version of this document (as

of this writing) is revision 5 dated March 3, 1998. It is available at <ftp://ftp.symbios.com/pub/standards/io/t10/drafts/mmc2/mmc2r05.pdf>.

The MMC-2 standard also defines the implementation for ~~For~~ ATAPI floppy drives and other ATAPI devices. Implementing media status notification for other ATAPI devices such as tape drives is not required. For other ATA and ATAPI devices, *Media Status Notification Support Specification, Version 1.03* or later, by Microsoft Corporation, defines the protocol to use for communicating about the current state of removable media. This specification is available at <http://www.microsoft.com/hwdev/specs/>.

For other ATAPI devices such as tape drives, media status notification is not required, but if it is implemented, the support must comply with SFF 8090.

Important: For CD-ROM and DVD-ROM devices, do not use *Media Status Notification Support Specification, Version 1.03* or earlier, as the guideline for implementing status notification on optical storage devices. This specification does not apply to optical storage devices because it does not contain packet-based support.

5. Dual ATA adapters use single FIFO with asynchronous access or dual FIFOs and channels allow software transparent asynchronous independent access to the two channels

Required

Dual ATA adapters must be designed so that either channel might be used at any time; that is, the operating system does not have to serialize access between the primary and secondary channel at any time. This means either that the two channels are totally independent or that anything shared, such as a programmed I/O (PIO) read pre-fetch buffer, is protected by a hardware arbitrator.

A design implementing a single first in/first out (FIFO) that uses a hardware solution to synchronize access to both channels meets this requirement if the design does not require that a request on one channel be completed before another can be started. A software-based solution is not acceptable.

Section 5.0 of the *Compaq, Intel, Phoenix BIOS Boot Specification* defines an implementation for dual asynchronous channels.

Dual-channel controllers that require special software to serialize channel I/O for a single prefetch FIFO do not meet these requirements. Such designs require serial access to one of four devices, defeating the primary advantage of asynchronous dual-channel controllers. Furthermore, such devices are non-standard and require custom driver support.

6. System BIOS and devices support LBA

Required

To enable support for ATA disk drives that ~~have are larger than~~ capacities greater than 528 MB (1,030,176 logical blocks), the system BIOS must use Logical

Block Addressing (that is, the LBA bit in the Device/Head register shall be set to one LBA) for all read and write operations to the device. The ATA 1226 technical report defines the proper implementation of logical block addressing.

The system BIOS must also be able to enable and disable block mode, and must be able to disable 32-bit mode as defined in ATA/PI-4 draft standard.

Although ATAPI was defined to be transparent to the BIOS, the BIOS must recognize the presence of ATAPI devices using the signature defined in SFF 8020i.

7. Controller and peripherals support Ultra-DMA/33

Required

The programming register set for PCI IDE bus master DMA is defined in SFF 8038iATA-4. ATA drives must comply with SFF 8038iATA-4 to ensure fully featured hardware and Windows-compatible device driver support.

All controllers and ATA peripherals must support Ultra DMA/33 (also known as Ultra-ATA) at transfer rates up to 33 MB/sec as defined in ATA/ATAPI-4 Revision 17. In addition to improved transfer rates, Ultra DMA/33 also provides error checking for improved robustness over previous ATA implementations. PCI chip sets must implement DMA as defined in SFF 8020i8038i. Ultra DMA/33 is only recommended for ATAPI devices and if a device does not support the Ultra DMA transfer protocol, it must, at least, implement the termination scheme required by this protocol to ensure that all devices coexist with UDMA-33 devices.

The system BIOS should configure the drive and host controller—optimized for Ultra DMA/33 operation if possible, though PIO mode must continue to work. The ACPI software should also support the restoration of these settings in ACPI control methods _GTM, _STM, and _GTF (for which ~~since there~~ are no standard registers for these) if the controller loses timing context across a suspend and resume cycle. The BIOS pre-operating system boot disk services (INT13h read and write) need not actually use Ultra DMA/33 for access of the drive prior to operating system boot.

Definitions for the above ACPI control methods can be found in Section 5 of the *Advanced Configuration and Power Interface Specification, Revision 1.0*. (See <http://www.teleport.com/~acpi/tech.htm>.)

8. Controller and peripheral connections include Pin 1 cable designation with keyed and shrouded connectors

Required

Pin 1 orientation must be designated by one edge of the keyed ribbon cable and also on the keyed connector of the ATA or ATAPI controller and peripheral device. Designation of the keyed connector must be clearly indicated on or near the connector.

ATAPI Peripheral General Requirements

This section defines the requirements for all ATAPI devices. Specific requirements for ATA floppy drives, hard drives, CD-ROM, and DVD devices are defined in the “Storage and Related Peripherals” chapter in Part 4 of this guide.

9. Peripherals comply with ATA/ATAPI-4 SFF 8020i, Version 2.5 or higher *Required*

This specification defines standard hardware and software design guidelines for ATAPI devices. See also the “System BIOS and option ROMs support Int 13h Extensions” requirement earlier in this chapter.

10. BIOS enumeration of all ATAPI devices complies with ATA/ATAPI-4 SFF 8020i, Version 2.5 or higher *Required*

ATA/ATAPI-4 ATAPI specification SFF 8020i, Version 2.5 or higher, defines the enumeration process for all ATAPI devices.

11. ATAPI Devices support ATAPI RESET command *Required*

ATAPI devices must respond to the ATAPI RESET command regardless of their internal state. Reset the controller by going into a power-on state (requests cleared, signature present), except leave any non-default mode values in their current state and leave the DRV bit unchanged. For more information, see Section 6.2 of SFF 8020i, Version 2.5 or later.

Plug and Play for ATA Controllers and Peripherals

This section summarizes the Plug and Play requirements for ATA controllers and peripherals.

12. Operating system recognizes the boot drive in a multiple-drive system *Required*

The implementation of boot-drive determination in multiple-drive systems is defined in Section 5.0 of the *Compaq, Intel, Phoenix BIOS Boot Specification*. This is the format that both Windows and Windows NT operating systems use for determining the boot drive as new bootable devices are introduced for PCs. The system designer can use an equivalent method for boot-drive determination, but the method must ensure that the Windows and Windows NT operating systems recognize the boot drive.

13. Each device has a Plug and Play device ID*Required*

For a system-board device, there must be a Plug and Play device-specific ID.

Each ATA controller or peripheral device must provide device IDs in the manner required for the bus it uses, as defined in the related chapter for the specific bus in Part 3 of this guide.

For example, an add-on PCI IDE device must comply with PCI 2.1 and also must provide a Subsystem ID and Subsystem Vendor ID as defined in the “PCI” chapter in Part 3 of this guide. PCI IDE controllers integrated into core logic on the system board do not have to provide Subsystem IDs and Subsystem Vendor IDs, but must meet other PCI 2.1 requirements.

14. Dynamic resource configuration supported for all devices*Required*

All devices must be capable of being automatically disabled by the system. Disabling a device must result in freeing all its resources for use by other devices.

Changing or adding a controller to the system must not require changing jumpers or switches on either the controller or the system board.

Note: This requirement does not apply to jumper settings used by the OEM to make basic system-related settings in the factory. This requirement applies only to settings that the end user must make to configure the hardware.

15. Resource configuration meets bus requirements*Required*

Plug and Play resource-configuration requirements are defined by the bus used by the ATA/ATAPI controllers and peripheral devices, as defined in the related chapter for the specific bus in Part 3 of this guide.

16. ISA address ranges 3F7h and 377h are not claimed by ATA controllers*Required*

Although ATA controllers might use these addresses, 3F7h and 377h also contain registers used by the FDC. To prevent resource conflicts, these addresses must not be claimed as device-register resources.

Power Management for ATA Devices

This section summarizes the specific ATA power management requirements. Power management requirements for peripherals that use ATA are defined in the related device-class chapters in Part 4 of this guide.

17. Device supports ATA STANDBY command

Required

The ATA drive must implement the ATA STANDBY command according to the ATA standard. This command is defined in ATA/ATAPI-4, the ATA-2 specification and in SFF 8020i.

Although not required, it is recommended that the hard disk drive spin-up and be able to complete a Read operation within 6 seconds of applying power and within 5 seconds of leaving ATA STANDBY mode and transitioning to ATA ACTIVE, as specified in the *Storage Device Class Power Management Reference Specification, Version 1.0* or later. This is not expected to become a requirement.

18. Bus and device meet PC 98 power management requirements

Required

The ATA channel must comply with the *Storage Device Class Power Management Reference Specification, Version 1.0* or later. Additional power management requirements are specified based on industry-defined standards for the bus used by the controller (such as PCI) and for the device. For more information, see the related chapter for the specific bus in Part 3 of this guide.

ATA and ATAPI References

The following represents some of the references, services, and tools available to help build hardware that is optimized to work with Windows operating systems.

ATA/ATAPI-4 Revision 17 Working Draft Standard

MMC-2 Multi-Media Command Set-2 revision 5

AT Attachment 3 [X3T10 2008D] standard

AT Attachment 2 [X3T9.2 948D] and other ATA standards

ATA Packet Interface for CD-ROM, SFF 8020i

<ftp://ftp.symbios.com/pub/standards/io/t10/drafts/mmc2/mmc2r05.pdf>

Compaq, Intel, Phoenix BIOS Boot Specification, Version 1.01

<http://www.ptltd.com/techs/specs.html>

El Torito—Bootable CD-ROM Format Specification, Version 1.0

Compaq, Intel, Phoenix BIOS Boot Specification, Version 1.01

<http://www.ptltd.com/techs/specs.html>

ATA and SCSI specifications

SFF Committee publications

FaxAccess: (408) 741-1600 (fax-back)

Fax: (408) 867-2115

Global Engineering Documents

Phone: (800) 854-7179 (US)

(613) 237-4250 (Canada)

(303) 792-2181 (Outside North America)

Fax: (303) 397-2740

<ftp://ftp.symbios.com/pub/standards/io/>

Some SFF Committee publications also available at

<ftp://fission.dt.wdc.com/pub/standards/SFF/specs/>

ATA DRAFT standards and other working documents are available at

<ftp://fission.dt.wdc.com/pub/standard/x3t13>

SCSI DRAFT standards and other working documents are available at

<ftp://ftp.symbios.com/pub/standards/io/t10/>

Media Status Notification Support Specification, Version 1.03

SMART IOCTL API Specification, Version 1.1

<http://www.microsoft.com/hwdev/specs/>

PCI Local Bus Specification, Revision 2.1 (PCI 2.1)

PCI SIG

Phone: (800) 433-5177

<http://www.pcisig.com>

Storage Device Class Power Management Reference Specification, Version 1.0

<http://www.microsoft.com/hwdev/onnow.htm>

Ultra DMA/33 specification

<http://www.quantum.com>

Windows DDK and Windows NT DDK

MSDN Professional membership

Checklist for ATA and ATAPI

If a recommended feature is implemented, it must meet the PC 98 requirements for that feature as defined in this document.

1. Controller complies with ATA-2, ATA-3, and ATA/ATAPI-4 standards
Required
2. Bootable ATA controller supports El Torito No Emulation mode
Required
3. System BIOS and option ROMs support Int 13h Extensions
Required
4. Peripherals support media status notification
Required
5. Dual ATA adapters use single FIFO with asynchronous access or dual FIFOs and channels
Required
6. System BIOS and devices support LBA
Required
7. Controller and peripherals support Ultra-DMA/33
Required
8. Controller and peripheral connections include Pin 1 cable designation with keyed and shrouded connectors
Required
9. Peripherals comply with ATA/ATAPI-4
Required
10. BIOS enumeration of all ATAPI devices complies with ATA/ATAPI-4
Required
11. ATAPI Devices support ATAPI RESET command
Required
12. Operating system recognizes the boot drive in a multiple-drive system
Required
13. Each device has a Plug and Play device ID
Required
14. Dynamic resource configuration supported for all devices
Required
15. Resource configuration meets bus requirements
Required
16. ISA address ranges 3F7h and 377h are not claimed by ATA controllers
Required
17. Device supports ATA STANDBY command
Required
18. Bus and device meet PC 98 power management requirements
Required

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